

**What Is Claimed Is:**

1. A planarization method comprising:
  - 5 positioning a metal-containing surface of a substrate to interface with a polishing surface, wherein the metal-containing surface comprises a metal selected from the group consisting of a Group VIII<sup>B</sup> metal, a Group IB metal, and a combination thereof;
  - supplying a planarization composition in proximity to the interface;
  - and
  - 10 planarizing the substrate surface;
  - wherein the planarization composition comprises a halogen-containing compound and a halide salt.
2. The method of claim 1 wherein the metal-containing surface of the substrate  
15 comprises a metal selected from the group consisting of a Group VIII<sup>B</sup> metal, a Group IB metal, and a combination thereof, which is in elemental form or an alloy thereof.
3. The method of claim 1 wherein the metal-containing surface of the substrate  
20 comprises a metal selected from the group consisting of a Group VIII<sup>B</sup> second row metal, a Group VIII<sup>B</sup> third row metal, a Group IB second row metal, a Group IB third row metal, and a combination thereof.
4. The method of claim 3 wherein the metal-containing surface of the substrate  
25 comprises a metal selected from the group consisting of Rh, Pd, Pt, Ir, and Ru.
5. The method of claim 4 wherein the metal-containing surface comprises elemental platinum.

6. The method of claim 1 wherein the metal is present in an amount of about 50 atomic percent or more.
- 5 7. The method of claim 1 wherein the substrate is a semiconductor substrate or substrate assembly.
8. The method of claim 1 wherein the polishing surface comprises a polishing pad and the planarization composition comprises a plurality of abrasive particles.
- 10 9. The method of claim 1 which is carried out in one step.
10. The method of claim 1 wherein the halogen-containing compound is selected from the group consisting of a halogen, an interhalogen, a halogen-generating compound, and combinations thereof.
- 15 11. The method of claim 10 wherein the halogen-containing compound is selected from the group consisting of  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$ ,  $ClBr$ ,  $IBr$ ,  $ICl$ ,  $BrF$ ,  $ClF$ ,  $ClF_3$ ,  $BrF_3$ ,  $ClF_5$ ,  $IF_5$ ,  $IF_7$ ,  $XeF_2$ ,  $HgF_2$ ,  $SF_4$ , alkyl halides, and complexes of  $X_2$  with organic bases, and combinations thereof.
- 20 12. The method of claim 1 wherein the halide salt is an inorganic salt.
13. The method of claim 12 wherein the inorganic halide salt is selected from the group consisting of  $NaI$ ,  $KCl$ ,  $KBr$ ,  $NH_4F$ , and combinations thereof.
- 25 14. The method of claim 1 wherein the halide salt is an organic salt.
15. The method of claim 14 wherein the organic salt is selected from the group consisting of  $Et_4NBr$ ,  $Me_3NHCl$ ,  $Me_4NF$ , and combinations thereof.
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- 5 16. The method of claim 1 wherein the halogen-containing compound is present in the planarization composition in an amount of at least about 0.1% by weight and the halide salt is present in the planarization composition in an amount of at least about 0.1% by weight.
17. The method of claim 1 wherein the polishing surface comprises a fixed abrasive article.
- 10 18. A planarization method comprising:  
providing a semiconductor substrate or substrate assembly including at least one region of a platinum-containing surface;  
providing a polishing surface;  
providing a planarization composition at an interface between the at  
15 least one region of platinum-containing surface and the polishing surface; and  
planarizing the at least one region of platinum-containing surface;  
wherein the planarization composition comprises a halogen-containing compound and a halide salt.
- 20 19. The method of claim 18 wherein the platinum-containing surface of the substrate comprises platinum in elemental form.
20. The method of claim 18 wherein the platinum is present in an amount of about 50 atomic percent or more.
- 25 21. The method of claim 18 wherein the semiconductor substrate or substrate assembly is a silicon wafer.

22. The method of claim 18 wherein the polishing surface comprises a polishing pad and the planarization composition comprises a plurality of abrasive particles.
- 5 23. The method of claim 18 wherein the halogen-containing compound is selected from the group consisting of a halogen, an interhalogen, a halogen-generating compound, and combinations thereof.
- 10 24. The method of claim 23 wherein the halogen-containing compound is selected from the group consisting of  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$ ,  $ClBr$ ,  $IBr$ ,  $ICl$ ,  $BrF$ ,  $ClF$ ,  $ClF_3$ ,  $BrF_3$ ,  $ClF_5$ ,  $IF_5$ ,  $IF_7$ ,  $XeF_2$ ,  $HgF_2$ ,  $SF_4$ , alkyl halides, and complexes of  $X_2$  with organic bases, and combinations thereof.
- 15 25. The method of claim 18 wherein the halide salt is an inorganic salt.
26. The method of claim 25 wherein the inorganic halide salt is selected from the group consisting of  $NaI$ ,  $KCl$ ,  $KBr$ ,  $NH_4F$  and combinations thereof.
- 20 27. The method of claim 18 wherein the halide salt is an organic salt.
28. The method of claim 27 wherein the organic salt is selected from the group consisting of  $Et_4NBr$ ,  $Me_3NHCl$ ,  $Me_4NF$ , and combinations thereof.
- 25 29. The method of claim 18 wherein the halogen-containing compound is present in the planarization composition in an amount of at least about 0.1% by weight and the halide salt is present in the planarization composition in an amount of at least about 0.1% by weight.
- 30 30. The method of claim 18 wherein the polishing surface comprises a fixed abrasive article.

31. A planarization method comprising:

positioning a metal-containing surface of a substrate to interface with  
a polishing surface, wherein the metal-containing surface comprises a metal  
selected from the group consisting of a Group VIIIB metal, a Group IB metal,  
and a combination thereof;

supplying a planarization composition in proximity to the interface;  
and

planarizing the substrate surface;

wherein the planarization composition comprises:

a halogen-containing compound selected from the group  
consisting of  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$ ,  $ClBr$ ,  $IBr$ ,  $ICl$ ,  $BrF$ ,  $ClF$ ,  $ClF_3$ ,  $BrF_3$ ,  
 $ClF_5$ ,  $IF_5$ ,  $IF_7$ ,  $XeF_2$ ,  $HgF_2$ ,  $SF_4$ , alkyl halides, and complexes of  $X_2$   
with organic bases, and combinations thereof; and

a halide salt selected from the group consisting of  $NaI$ ,  $KCl$ ,  
 $KBr$ ,  $NH_4F$ ,  $Et_4NBr$ ,  $Me_3NHCl$ ,  $Me_4NF$ , and combinations thereof.

32. The method of claim 31 wherein the halogen-containing compound is present  
in the planarization composition in an amount of about 1% to about 10% by  
weight.

33. The method of claim 31 wherein the halide salt is present in the planarization  
composition in an amount of about 1% to about 10% by weight.

34. A planarization method comprising:

providing a semiconductor substrate or substrate assembly including at  
least one region of a platinum-containing surface;

providing a polishing surface;

providing a planarization composition at an interface between the at  
least one region of platinum-containing surface and the polishing surface; and

planarizing the at least one region of platinum-containing surface;  
wherein the planarization composition comprises:

a halogen-containing compound selected from the group  
consisting of  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$ ,  $ClBr$ ,  $IBr$ ,  $ICl$ ,  $BrF$ ,  $ClF$ ,  $ClF_3$ ,  $BrF_3$ ,  
5  $ClF_5$ ,  $IF_5$ ,  $IF_7$ ,  $XeF_2$ ,  $HgF_2$ ,  $SF_4$ , alkyl halides, and complexes of  $X_2$   
with organic bases, and combinations thereof; and

a halide salt selected from the group consisting of  $NaI$ ,  $KCl$ ,  
 $KBr$ ,  $NH_4F$ ,  $Et_4NBr$ ,  $Me_3NHCl$ ,  $Me_4NF$ , and combinations thereof.

10 35. The method of claim 34 wherein the halogen-containing compound is present  
in the planarization composition in an amount of about 1% to about 10% by  
weight.

15 36. The method of claim 34 wherein the halide salt is present in the planarization  
composition in an amount of about 1% to about 10% by weight.

37. A planarization method for use in forming an interconnect, the method  
comprising:

20 providing a semiconductor substrate or substrate assembly having a  
patterned dielectric layer formed thereon and a metal-containing layer formed  
over the patterned dielectric layer, wherein the metal-containing layer  
comprises a metal selected from the group consisting of a Group VIII B metal,  
a Group IB metal, and a combination thereof;

25 positioning a first portion of a polishing surface for contact with the  
metal-containing layer;

providing a planarization composition in proximity to the contact  
between the polishing surface and the metal-containing layer; and

planarizing the metal-containing layer;

30 wherein the planarization composition comprises a halogen-containing  
compound and a halide salt.

38. The method of claim 37 wherein the polishing surface comprises a polishing pad and the planarization composition comprises a plurality of abrasive particles.
- 5 39. The method of claim 37 wherein the halogen-containing compound is selected from the group consisting of a halogen, an interhalogen, a halogen-generating compound, and combinations thereof.
- 10 40. The method of claim 39 wherein the halogen-containing compound is selected from the group consisting of  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$ ,  $ClBr$ ,  $IBr$ ,  $ICl$ ,  $BrF$ ,  $ClF$ ,  $ClF_3$ ,  $BrF_3$ ,  $ClF_5$ ,  $IF_5$ ,  $IF_7$ ,  $XeF_2$ ,  $HgF_2$ ,  $SF_4$ , alkyl halides, and complexes of  $X_2$  with organic bases, and combinations thereof.
- 15 41. The method of claim 37 wherein the halide salt is an inorganic salt.
42. The method of claim 41 wherein the inorganic halide salt is selected from the group consisting of  $NaI$ ,  $KCl$ ,  $KBr$ ,  $NH_4F$  and combinations thereof.
- 20 43. The method of claim 37 wherein the halide salt is an organic salt.
44. The method of claim 43 wherein the organic salt is selected from the group consisting of  $Et_4NBr$ ,  $Me_3NHCl$ ,  $Me_4NF$ , and combinations thereof.
- 25 45. The method of claim 37 wherein the halogen-containing compound is present in the planarization composition in an amount of at least about 0.1% by weight.
- 30 46. The method of claim 45 wherein the halogen-containing compound is present in the planarization composition in an amount of about 1% to about 10% by weight.

47. The method of claim 37 wherein the halide salt is present in the planarization composition in an amount of at least about 0.1% by weight.

5 48. The method of claim 47 wherein the halide salt is present in the planarization composition in an amount of about 1% to about 10% by weight.

49. The method of claim 37 wherein the polishing surface comprises a fixed abrasive article.

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50. A planarization method for use in forming an interconnect, the method comprising:

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providing a semiconductor substrate or substrate assembly having a patterned dielectric layer formed thereon and a metal-containing layer formed over the patterned dielectric layer, wherein the metal-containing layer comprises a metal selected from the group consisting of a Group VIII B metal, a Group IB metal, and a combination thereof;

positioning a first portion of a polishing surface for contact with the metal-containing layer;

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providing a planarization composition in proximity to the contact between the polishing surface and the metal-containing layer; and planarizing the metal-containing layer;

wherein the planarization composition comprises:

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a halogen-containing compound selected from the group consisting of  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$ ,  $ClBr$ ,  $IBr$ ,  $ICl$ ,  $BrF$ ,  $ClF$ ,  $ClF_3$ ,  $BrF_3$ ,  $ClF_5$ ,  $IF_5$ ,  $IF_7$ ,  $XeF_2$ ,  $HgF_2$ ,  $SF_4$ , alkyl halides, and complexes of  $X_2$  with organic bases, and combinations thereof; and

a halide salt selected from the group consisting of  $NaI$ ,  $KCl$ ,  $KBr$ ,  $NH_4F$ ,  $Et_4NBr$ ,  $Me_3NHCl$ ,  $Me_4NF$ , and combinations thereof.

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51. A planarization method comprising:  
positioning a metal-containing surface of a substrate to interface with  
a polishing surface, wherein the metal-containing surface comprises a metal  
selected from the group consisting of a Group VIIIIB metal, a Group IB  
5 metal, and a combination thereof;  
supplying a planarization composition in proximity to the interface;  
and  
planarizing the substrate surface;  
wherein the planarization composition comprises a halogen-containing  
10 compound and a halide salt, with the proviso that the planarization composition does  
not include abrasive particles.
52. The method of claim 51 wherein the metal-containing surface of the substrate  
comprises a metal selected from the group consisting of a Group VIIIIB metal, a  
15 Group IB metal, and a combination thereof, which is in elemental form or an alloy  
thereof.
53. The method of claim 51 wherein the metal-containing surface of the substrate  
comprises a metal selected from the group consisting of a Group VIIIIB second row  
20 metal, a Group VIIIIB third row metal, a Group IB second row metal, a Group IB  
third row metal, and a combination thereof.
54. The method of claim 53 wherein the metal-containing surface of the substrate  
comprises a metal selected from the group consisting of Rh, Pd, Pt, Ir, and Ru.  
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55. The method of claim 54 wherein the metal-containing surface comprises  
elemental platinum.

56. The method of claim 51 wherein the metal is present in an amount of about 50 atomic percent or more.
57. The method of claim 51 wherein the substrate is a semiconductor substrate or substrate assembly.
58. The method of claim 51 which is carried out in one step.
59. The method of claim 51 wherein the halogen-containing compound is selected from the group consisting of a halogen, an interhalogen, a halogen-generating compound, and combinations thereof.
60. The method of claim 51 wherein the halogen-containing compound is selected from the group consisting of a halogen; an interhalogen; a halogen-generating compound selected from the group consisting of XeF<sub>2</sub>, HgF<sub>2</sub>, SF<sub>4</sub>, alkyl halides, and complexes of halogen with organic bases; and combinations thereof.
61. The method of claim 51 wherein the halogen-containing compound is selected from the group consisting of F<sub>2</sub>, Cl<sub>2</sub>, Br<sub>2</sub>, I<sub>2</sub>, ClBr, IBr, ICl, BrF, ClF, ClF<sub>3</sub>, BrF<sub>3</sub>, ClF<sub>5</sub>, IF<sub>5</sub>, IF<sub>7</sub>, XeF<sub>2</sub>, HgF<sub>2</sub>, SF<sub>4</sub>, alkyl halides, and complexes of halogen with organic bases, and combinations thereof.
62. The method of claim 51 wherein the halogen-containing compound is selected from the group consisting of ClBr, IBr, ICl, BrF, ClF, ClF<sub>3</sub>, BrF<sub>3</sub>, ClF<sub>5</sub>, IF<sub>5</sub>, IF<sub>7</sub>, XeF<sub>2</sub>, HgF<sub>2</sub>, SF<sub>4</sub>, alkyl halides, and complexes of halogen with organic bases, and combinations thereof.
63. The method of claim 51 wherein the halide salt is an inorganic salt.

64. The method of claim 63 wherein the inorganic halide salt is selected from the group consisting of NaI, KCl, KBr,  $\text{NH}_4\text{F}$ , and combinations thereof.
- 5 65. The method of claim 51 wherein the halide salt is an organic salt.
66. The method of claim 65 wherein the organic salt is selected from the group consisting of  $\text{Et}_4\text{NBr}$ ,  $\text{Me}_3\text{NHCl}$ ,  $\text{Me}_4\text{NF}$ , and combinations thereof.
- 10 67. The method of claim 51 wherein the halogen-containing compound is present in the planarization composition in an amount of at least about 0.1% by weight and the halide salt is present in the planarization composition in an amount of at least about 0.1% by weight.
- 15 68. The method of claim 51 wherein the halogen-containing compound is present in the planarization composition in an amount of about 1% to about 10% by weight.
69. The method of claim 51 wherein the halide salt is present in the planarization composition in an amount of about 1% to about 10% by weight.
- 20 70. The method of claim 51 wherein the halogen of the halogen-containing compound is different than the halogen of the halide salt.
71. The method of claim 51 wherein the planarization composition is not basic.
- 25 72. The method of claim 51 wherein the polishing surface comprises a fixed abrasive article.
73. A planarization method comprising:  
providing a semiconductor substrate or substrate assembly including at  
30 least one region of a platinum-containing surface;

- providing a polishing surface;  
providing a planarization composition at an interface between the at  
least one region of platinum-containing surface and the polishing surface;  
and
- 5            planarizing the at least one region of platinum-containing surface;  
             wherein the planarization composition comprises a halogen-containing  
compound and a halide salt, with the proviso that the planarization composition does  
not include abrasive particles.
- 10        74.     The method of claim 73 wherein the platinum-containing surface of the  
             substrate comprises platinum in elemental form.
75.     The method of claim 73 wherein the platinum is present in an amount of  
             about 50 atomic percent or more.
- 15        76.     The method of claim 73 wherein the semiconductor substrate or substrate  
             assembly is a silicon wafer.
77.     The method of claim 73 wherein the halogen-containing compound is  
20        selected from the group consisting of a halogen, an interhalogen, a halogen-  
             generating compound, and combinations thereof.
78.     The method of claim 73 wherein the halogen-containing compound is  
             selected from the group consisting of a halogen; an interhalogen; a halogen-  
25        generating compound selected from the group consisting of XeF<sub>2</sub>, HgF<sub>2</sub>, SF<sub>4</sub>, alkyl  
             halides, and complexes of halogen with organic bases; and combinations thereof.
79.     The method of claim 73 wherein the halogen-containing compound is  
             selected from the group consisting of F<sub>2</sub>, Cl<sub>2</sub>, Br<sub>2</sub>, I<sub>2</sub>, ClBr, IBr, ICl, BrF, ClF, ClF<sub>3</sub>,

BrF<sub>3</sub>, ClF<sub>5</sub>, IF<sub>5</sub>, IF<sub>7</sub>, XeF<sub>2</sub>, HgF<sub>2</sub>, SF<sub>4</sub>, alkyl halides, and complexes of halogen with organic bases, and combinations thereof.

80. The method of claim 73 wherein the halide salt is an inorganic salt.

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81. The method of claim 80 wherein the inorganic halide salt is selected from the group consisting of NaI, KCl, KBr, NH<sub>4</sub>F and combinations thereof.

82. The method of claim 73 wherein the halide salt is an organic salt.

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83. The method of claim 82 wherein the organic salt is selected from the group consisting of Et<sub>4</sub>NBr, Me<sub>3</sub>NHCl, Me<sub>4</sub>NF, and combinations thereof.

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84. The method of claim 73 wherein the halogen-containing compound is present in the planarization composition in an amount of at least about 0.1% by weight and the halide salt is present in the planarization composition in an amount of at least about 0.1% by weight.

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85. The method of claim 73 wherein the halogen-containing compound is present in the planarization composition in an amount of about 1% to about 10% by weight.

86. The method of claim 73 wherein the halide salt is present in the planarization composition in an amount of about 1% to about 10% by weight.

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87. The method of claim 73 wherein the polishing surface comprises a fixed abrasive article.

88. A planarization method for use in forming an interconnect, the method comprising:

providing a semiconductor substrate or substrate assembly having a patterned dielectric layer formed thereon and a metal-containing layer formed over the patterned dielectric layer, wherein the metal-containing layer comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;

5 positioning a first portion of a polishing surface for contact with the metal-containing layer;

providing a planarization composition in proximity to the contact between the polishing surface and the metal-containing layer; and

10 planarizing the metal-containing layer;

wherein the planarization composition comprises a halogen-containing compound and a halide salt, with the proviso that the planarization composition does not include abrasive particles.

15 89. The method of claim 88 wherein the halogen-containing compound is selected from the group consisting of a halogen, an interhalogen, a halogen-generating compound, and combinations thereof.

20 90. The method of claim 88 wherein the halogen-containing compound is selected from the group consisting of a halogen; an interhalogen; a halogen-generating compound selected from the group consisting of XeF<sub>2</sub>, HgF<sub>2</sub>, SF<sub>4</sub>, alkyl halides, and complexes of halogen with organic bases; and combinations thereof.

25 91. The method of claim 88 wherein the halogen-containing compound is selected from the group consisting of F<sub>2</sub>, Cl<sub>2</sub>, Br<sub>2</sub>, I<sub>2</sub>, ClBr, IBr, ICl, BrF, ClF, ClF<sub>3</sub>, BrF<sub>3</sub>, ClF<sub>5</sub>, IF<sub>5</sub>, IF<sub>7</sub>, XeF<sub>2</sub>, HgF<sub>2</sub>, SF<sub>4</sub>, alkyl halides, and complexes of halogen with organic bases, and combinations thereof.

30 92. The method of claim 88 wherein the halide salt is an inorganic salt.

93. The method of claim 92 wherein the inorganic halide salt is selected from the group consisting of NaI, KCl, KBr,  $\text{NH}_4\text{F}$  and combinations thereof.
94. The method of claim 88 wherein the halide salt is an organic salt.
- 5 95. The method of claim 94 wherein the organic salt is selected from the group consisting of  $\text{Et}_4\text{NBr}$ ,  $\text{Me}_3\text{NHCl}$ ,  $\text{Me}_4\text{NF}$ , and combinations thereof.
- 10 96. The method of claim 88 wherein the halogen-containing compound is present in the planarization composition in an amount of at least about 0.1% by weight.
97. The method of claim 96 wherein the halogen-containing compound is present in the planarization composition in an amount of about 1% to about 10% by weight.
- 15 98. The method of claim 88 wherein the halide salt is present in the planarization composition in an amount of at least about 0.1% by weight.
99. The method of claim 98 wherein the halide salt is present in the planarization composition in an amount of about 1% to about 10% by weight.
- 20 100. The method of claim 88 wherein the polishing surface comprises a fixed abrasive article.
101. A planarization method comprising:
- 25       positioning a metal-containing surface of a substrate to interface with a polishing surface comprising a fixed abrasive article, wherein the metal-containing surface comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;
- supplying a planarization composition in proximity to the interface;
- 30       and

planarizing the substrate surface;  
wherein the planarization composition comprises a halogen-containing compound and a halide salt.

5      102. A planarization method comprising:

providing a semiconductor substrate or substrate assembly including at least one region of a platinum-containing surface;

providing a polishing surface comprising a fixed abrasive article;

10      providing a planarization composition at an interface between the at least one region of platinum-containing surface and the polishing surface; and

planarizing the at least one region of platinum-containing surface;  
wherein the planarization composition comprises a halogen-containing compound and a halide salt.

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103. A planarization method for use in forming an interconnect, the method comprising:

providing a semiconductor substrate or substrate assembly having a patterned dielectric layer formed thereon and a metal-containing layer formed over the patterned dielectric layer, wherein the metal-containing layer comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;

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positioning a first portion of a polishing surface comprising a fixed abrasive article for contact with the metal-containing layer;

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providing a planarization composition in proximity to the contact between the polishing surface and the metal-containing layer; and

planarizing the metal-containing layer;

wherein the planarization composition comprises a halogen-containing compound and a halide salt.

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